

Collective evolution of a parton in the vacuum: Search for the ultimate partonic “droplet”

<https://arxiv.org/pdf/2104.11735.pdf>

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Acknowledgement

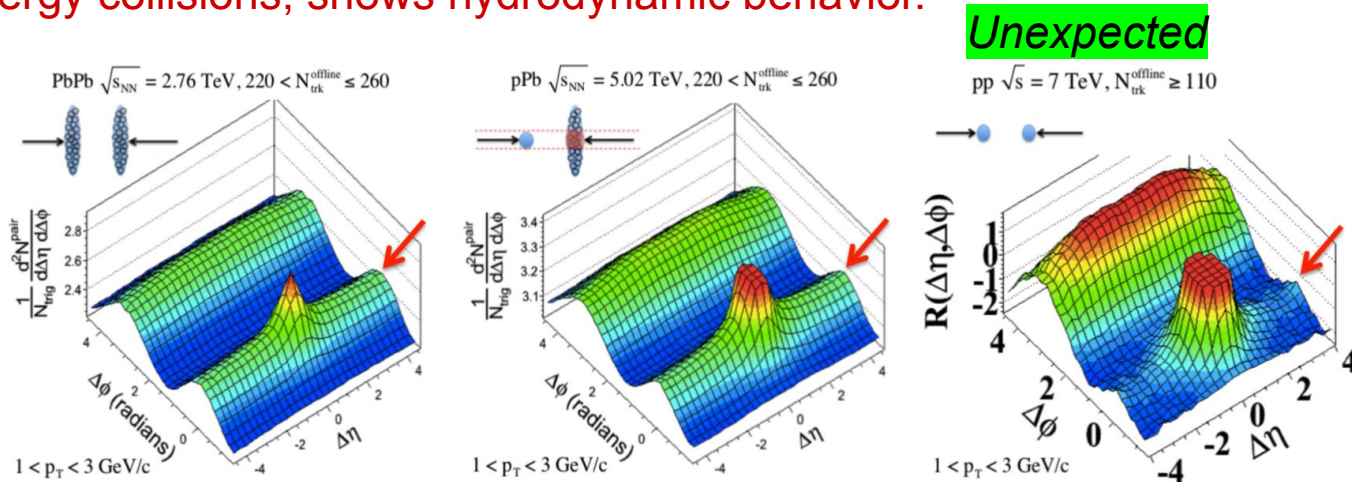


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A 'Ridge' from AA to pp and Old Mysteries in e^+e^-

- Matter with quark-gluon degrees of freedom is discovered in high energy collisions, shows hydrodynamic behavior.



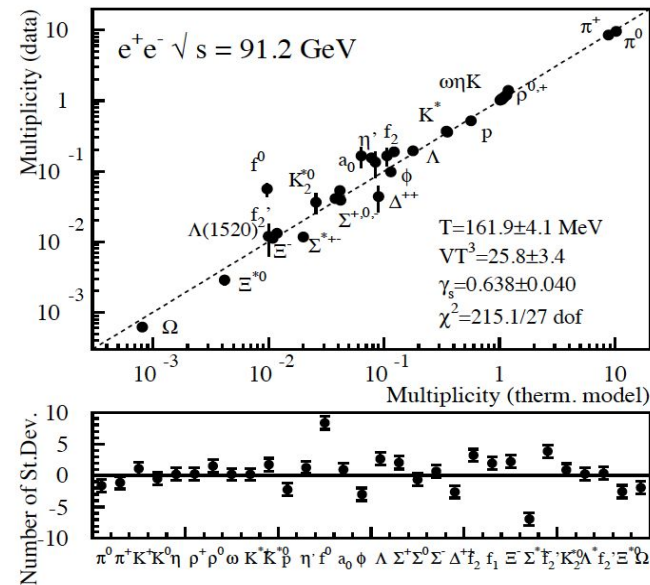
- Hadron production in elementary collisions well described by thermal gas approach.

A thermodynamical approach to hadron production in e^+e^- collisions

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Important Questions and an Interesting Proposal

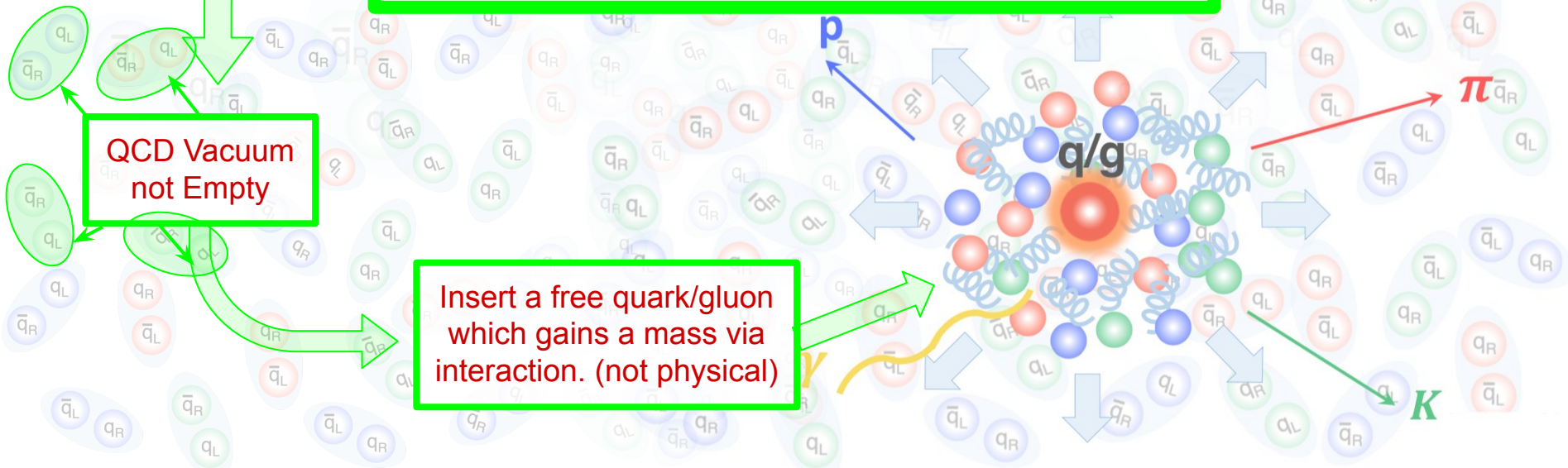
- From how small of a system can partonic collectivity emerge?
- Is partonic collectivity at small scales unexpected or a natural consequence of QCD
- Can hydrodynamics describe non-perturbative dynamics (e.g., parton evolution and fragmentation in the vacuum)?

We propose that:

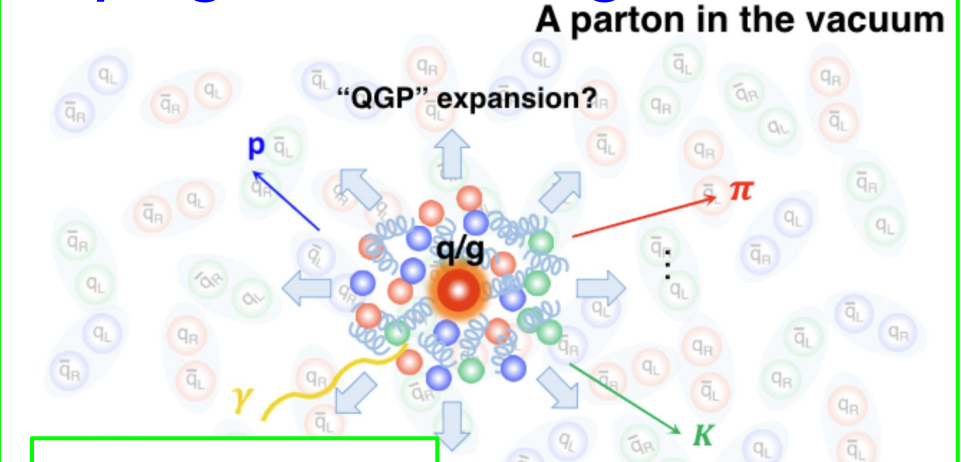
A strongly interacting QGP-like state can be formed by a system as small as a single quark or gluon propagating through the QCD vacuum.

QCD Vacuum
not Empty

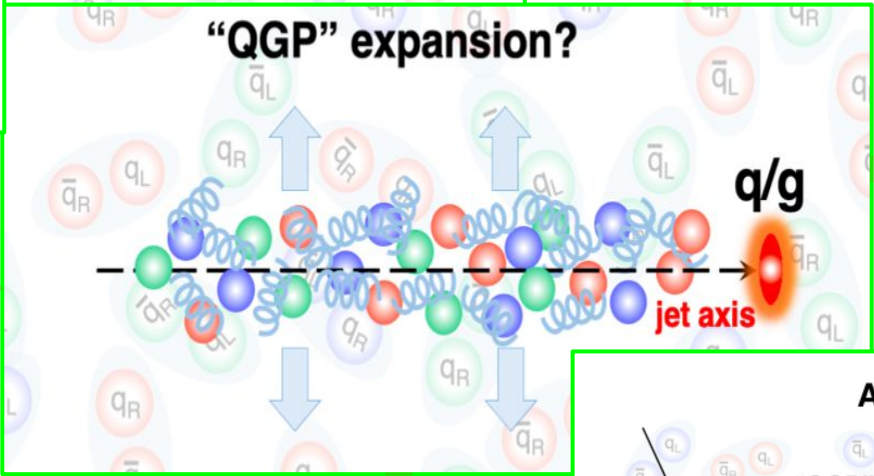
Insert a free quark/gluon
which gains a mass via
interaction. (not physical)



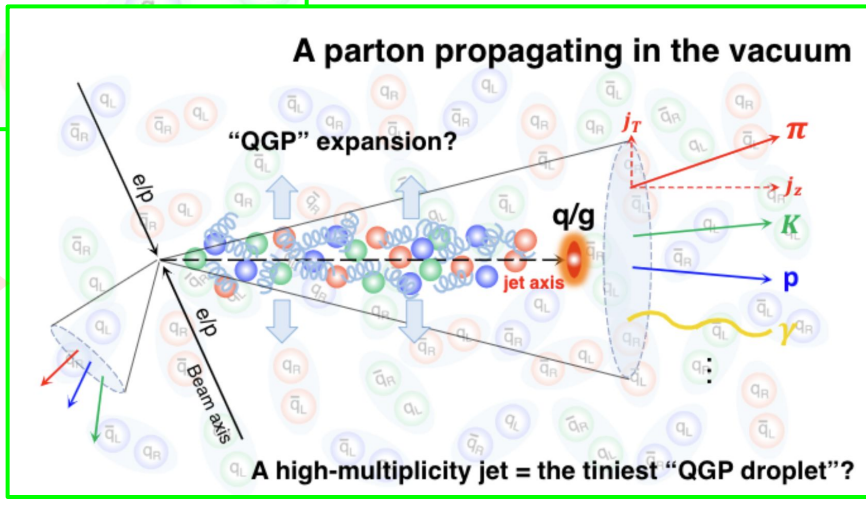
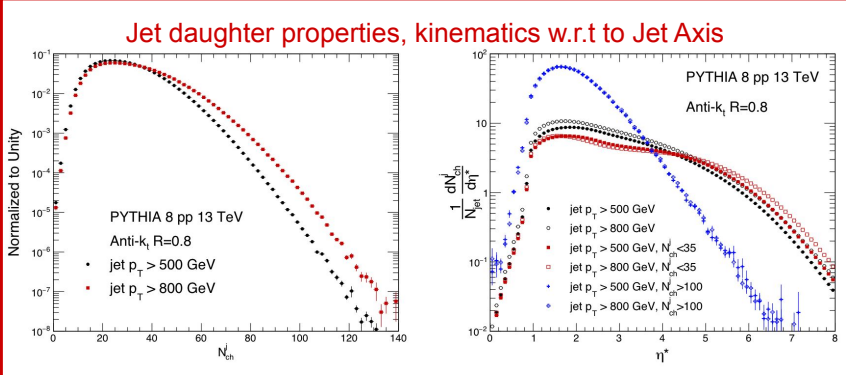
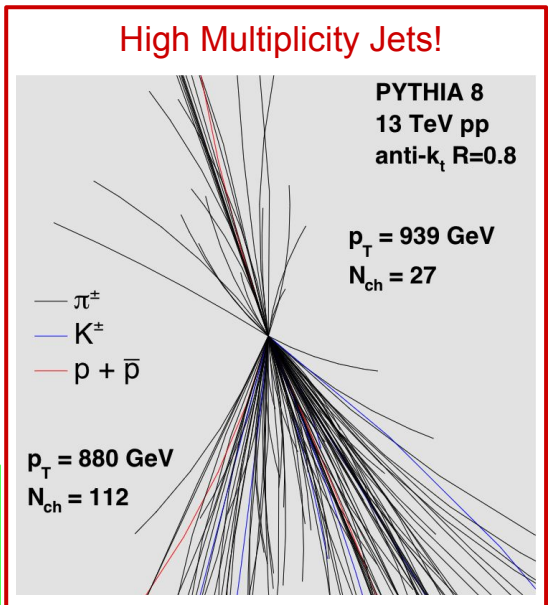
Propagation Along Jet Axis, New Reference Frame



Insert a free quark/gluon which gains a mass via interaction. (not physical)

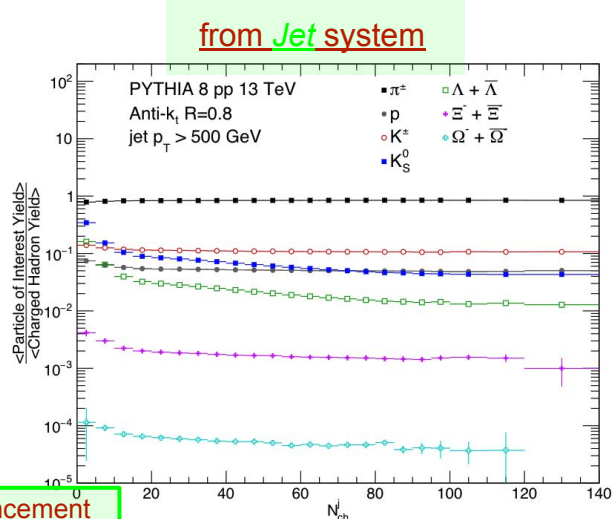


Jet Axis, not Collision Axis



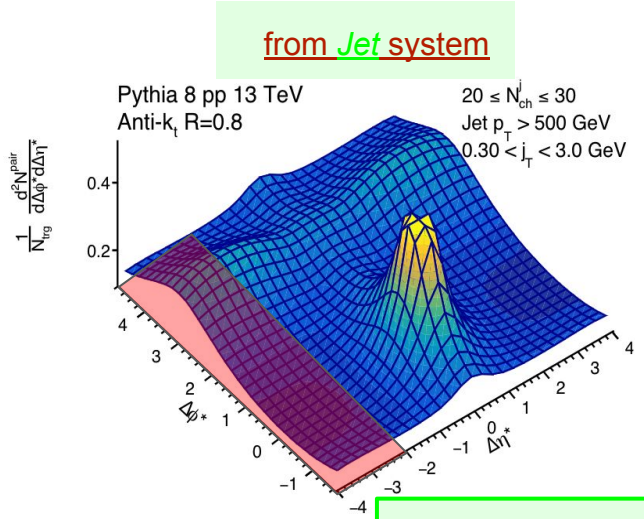
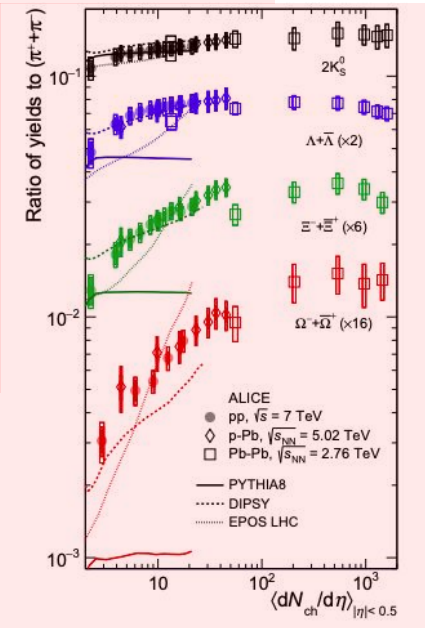
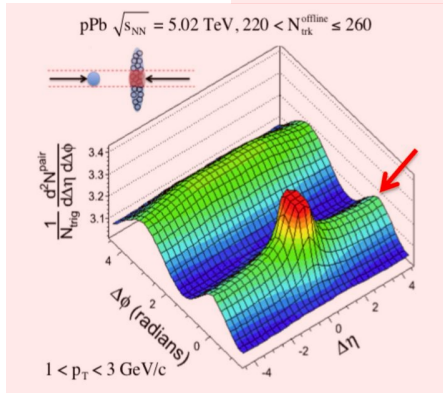
Observables in new Jet system

Previous QGP Measurements

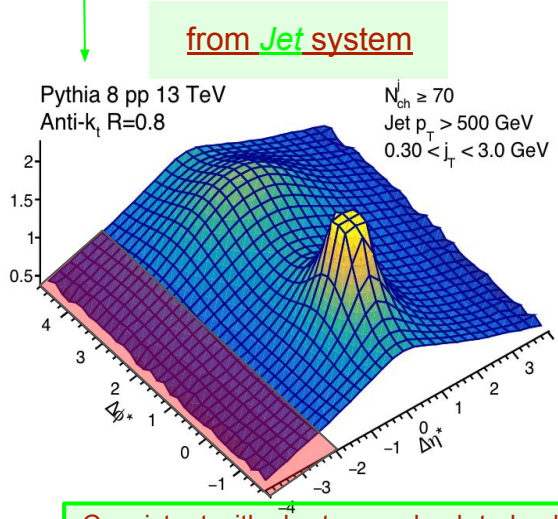


Strange enhancement in AA collisions is strong evidence for high gluon density state.

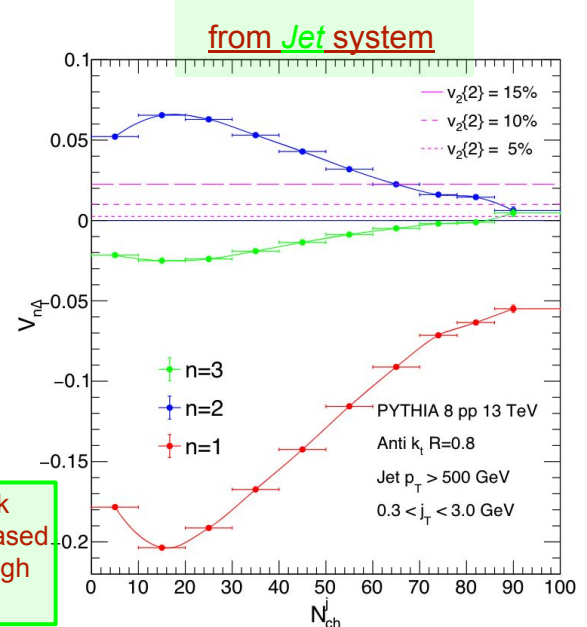
• Strangeness enhancement in a dense partonic medium.
 • Long-range correlations and anisotropy flow.



Particle production dynamics seem similar to collisions with respect to beam axis.



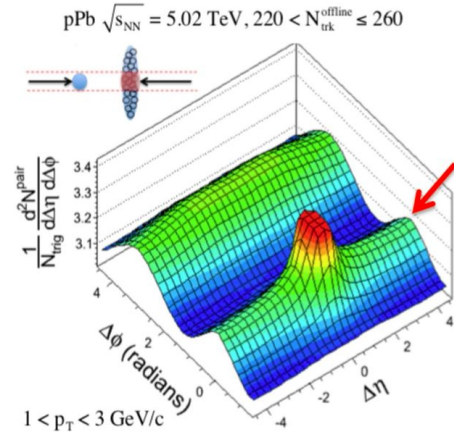
Consistent with short-range back-to-back correlations, not collective effects. Increased V_{2Δ} or significant positive V_{3Δ} at very high multiplicity could indicate collective flow



Summary:

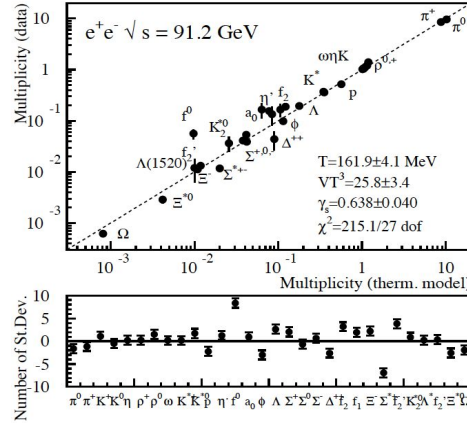
Motivated by collective phenomena in small system collisions, we postulate that non-perturbative QCD evolution of a single parton in the vacuum will develop long-range collective effects.

Surprises...



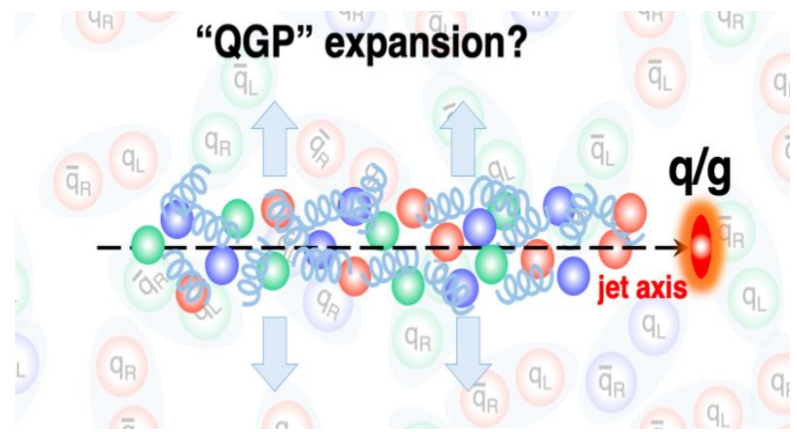
Ridges in AA to pp

Mysteries...

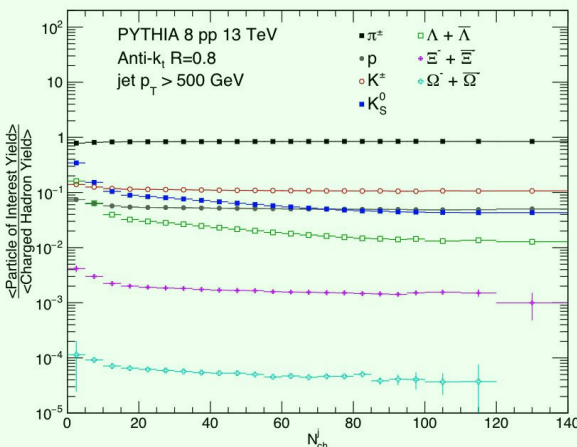


e^+e^-

...and a Proposal



Using pp jets for partons propagating in vacuum



Observables in new Jet system

